Entrance exam - Informatics
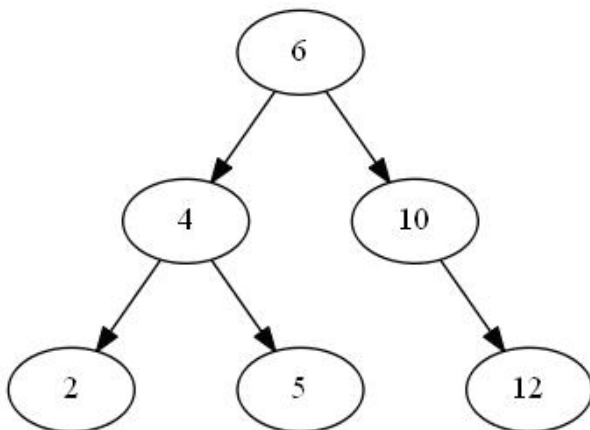
Name and Surname – fill in the field	Application No.	Test Sheet No.
		15

Algorithms and data structures

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1 Which of the listed data structures is most suitable (w.r.t. time and memory complexity) to implement the evaluation of an arithmetic expression in the postfix notation?

A weighted graph
B priority queue
C set
*D stack
E hash table

2

Consider the binary search tree shown above. Starting from an empty tree, which of the following input sequences of integers could produce the binary tree above (no balancing was done during the key insertion)?

A 6, 10, 2, 12, 4, 5
B 6, 12, 5, 10, 4, 2
C 6, 5, 12, 4, 10, 2
***D** 6, 4, 5, 10, 2, 12
E 6, 4, 2, 12, 10, 5

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3 Which of the listed data structures is most suitable for maintaining compiler's symbol table (e.g., for defined variables, functions, ...) created during the program compilation?

A linked list
B priority queue
C set
D stack
*E hash table

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4 If a hash function F is used for the implementation of hash tables, collisions may occur. One of the potential solutions is repeated hashing - when a collision is produced, the colliding address is hashed again and the new result is used as a new address for a storage of given item. Which of the statements is correct?

A The time complexity of an insertion of any item is O(1) and all items can be always inserted.

B Repeated hashing solves the problem of collisions, because no collision can occur.

*C If the searched item is present inside the hash table, time complexity to look up for this key is O(n).

D Repeated hashing is equivalent to storing collisions in a linked list (from the perspective of the possibility to add new item into hash table).

E Repeated hashing with the same function F cannot be used. A different hashing function F_i must be used for every hashing iteration.

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5 Which of the listed statements holds for revision control tools (SVN, Git, Mercury, ...)? Choose an option with all correct statements.

*A A revision control tool allows multiple developers to work on the same project; allows returning to any past version; allows creating a separate development branch with the possibility for a later merge into the main project; allows committing modified files to a repository (Commit).

B A revision control tool permits only a single developer to work on the given project; allows returning to any past version; provides backup of the source code outside the directory with source files; allows creating a separate development branch with the possibility for a later merge into the main project; allows obtaining a newer version of files from the repository (Update).

C A revision control tool allows multiple developers to work on the same project; allows obtaining the most current version (head); allows creating a separate development branch, but without the possibility for a later merge into the main project; allows committing modified files to the repository (Commit).

D A revision control tool allows multiple developers to work on the same project; allows creating a separate development branch with the possibility for a later merge into the main project; allows obtaining a newer version of files from the repository (Update); automatically erases older versions of files from the repository after the file is downloaded by all developers via the Update command.

E A revision control of source code files is typically not used, only compiled binary files are versioned; revision control tool allows creating a separate development branch with the possibility for a later merge into the main project; allows obtaining newer version of files from repository (Update).

Databases

6 Look at the following E-R diagram:
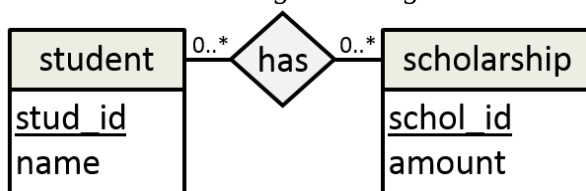
Select the correct answer:

A A student can receive maximally one scholarship.

B Scholarship can be awarded to maximally one student.

C Each scholarship must be awarded to at least one student.

*D A student can receive multiple scholarships.

E Each student has at least one scholarship.

7 Let a relational database contain the tables *employee* (#ID, name, salary), *project* (#ID, name), and *work_on* (#ID_employee, #ID_project). The table primary keys are denoted by the # symbol, the attributes ID_employee and ID_project in the table *work_on* are foreign keys referencing the tables *employee* and *project*, respectively. What is the result of the following SQL query:

```
SELECT name
FROM project, work_on
WHERE id_project=id AND name LIKE '%oracle%'
GROUP BY id,name HAVING count(*)>=5;
```

*A The names of projects that have a substring 'oracle' in their names and there are at least 5 employees working on them.

B The names of projects that have a substring 'oracle' in their names and no employee is working on them.

C The names of employees that work on at least 5 projects and the names of which contain a substring 'oracle'.

D The number of projects, the names of which contain a substring 'oracle'.

E The names of all projects having at least 5 employees working on them.

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8 Select a statement that is true for any candidate key (CK):

A There is one CK for any entity set.

B CK is the maximal number of dependencies.

*C CK is a superkey.

D CK has always at least two attributes.

E CK is an arbitrary subset of attributes.

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9 Select the correct requirement for the First Normal Form (1NF):

*A All attributes must be atomic.

B The ACID rules must hold for all attributes.

C All dependencies must be atomic.

D All normal forms must be atomic.

E All dependencies must be atomic and the requirements of the Second Normal Form (2NF) must hold.

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10 The Structured Query Language (SQL):

*A is a declarative language

B is an imperative language

C is based on evolutionary programming techniques

D is based on the XML language

E works reliably only if a superkey is specified for any operation

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Computer systems

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11 Which decimal number is equivalent to the number expressed in hexadecimal form as 2FE?

*A 766

B 667

C 777

D 666

E 1011111110

12 DMA (Direct Memory Access) is used to:

 *A transfer data between memory and I/O devices without copying data to the processor registers

 B transfer data between memory and I/O devices copying data to the processor registers

 C transfer data between memory and processor cache without copying data to the processor registers

 D transfer data between memory and processor cache copying data to the processor registers

 E transfer data between the processor registers

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13 Consider the binary eight-bit two's complement representation. The decimal number -11 is represented in such notation as:

 *A 11110101

 B 11110100

 C 00001011

 D 00001100

 E 00001101

---

14 Which system call is used to create a new process in the UNIX operating system:

 *A fork

 B execve

 C pthread_create

 D ptrace

 E _exit

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15 Suppose processes P1, P2, P3 were created at time 0. The process P1 needs for its running 8 units of CPU, the process P2 needs 3 units and the process P3 needs 5 units. We only have a single processor and the CPU scheduling algorithm is based on the preemptive version of the SJF (Shortest Job First) algorithm. Which process will be running on the CPU at the time slot 6 units of CPU (from the time 0)?

 A P1

 B P2

 *C P3

 D P1 and P2

 E None of the processes

Programming

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16 A programmer has to write a program, which takes one-dimensional array of bit answers (uint32 answers[X]) of the length X, where X is the number of participants. As fast as possible, the program should evaluate (on x86 architecture), whether the number of YES answers over all participants for a given question is even. The program will return OK if this property holds for all 32 questions, NOK otherwise.

 A Program will need to execute at least 32 * X comparison operations.

 B Program will need to execute at least 32 * (X-1) addition operations and 32 comparison operations.

 C Program will need to execute at least 32 exclusive or (xor) operations and (X-1) comparison operations.

 D Program will need to execute at least X-1 addition operations and 32 comparison operations.

 *E Program will need to execute at least X-1 exclusive or (xor) operations and 1 comparison operation.

17
```
integer foo(integer x, integer y, integer z)
begin
  if (x < 10) then y = 40
  z = x - y
  return y - z
end

program main()
begin
  integer a, b, c, d
  a = 10
  b = 20
  c = 30
  d = 40
  d = foo(a, b, c)
  print a, b, c, d
end
```

Assume that the function foo() uses call-by-reference. What would be printed as a result of executing the pseudocode? (Order of print of variables is a b c d)

A 10 20 30 30
*B 10 20 -10 30
C 10 40 -30 70
D 10 20 30 70
E 10 20 30 40

18
```
// PSEUDOCODE 1
sum = 0
for i = 1 to n {
  sum = sum + i
}
print sum

// PSEUDOCODE 2
sum = 0
i = <initial_value>
do {
  sum = sum + i
  i = i + 1
} while ( <condition> )
print sum
```

All the variables in the two listed pseudocodes are of signed integer type and n >= 1. Which of the following options can be used to replace <initial_value> and <condition> so that PSEUDOCODE 1 will produce the same output as PSEUDOCODE 2?

A <initial_value> = 0; <condition> = i < n
B <initial_value> = 0; <condition> = i < n - 1
*C <initial_value> = 0; <condition> = i < n + 1
D <initial_value> = 1; <condition> = i < n - 1
E <initial_value> = 1; <condition> = i < n

19 Decide (exactly) which of the following statements is valid in common OOP languages (C++, Java, C#):

*A If a method is virtual in class X, its implementation can be changed in the classes inheriting from X.

B If a method is virtual in class X, its implementation cannot be changed in the classes inheriting from X.

C The overhead associated with call to virtual method is typically lower than for method called with early binding (non-virtual).

D A virtual method declared in class X can be changed to one called with early binding (non-virtual) in the classes inheriting from X.

E If a method is non-virtual in the class X, then it cannot be re-declared as a virtual method later in the classes inheriting from X.

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20 Decide which statement contains all valid and only valid options (for common languages like C++, Java, C#):

I. Local variables of executed function (stored on stack) are automatically removed when function ends.

II. A memory dynamically allocated on the heap is removed when explicit deallocation is called (languages without garbage collection) or memory is no longer referenced (languages with garbage collection).

III. A local variable stored on the stack cannot contain pointers to dynamically allocated memory on the heap.

A I.

B II.

*C I. and II.

D I. and II. and III.

E II. and III.

Computer Networks

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21 In the context of telecommunications and computer networks, multiplexing is a method that combines multiple signals into one signal over a shared medium. Select the statement that is true:

A Both the analog and the digital signals can be multiplexed in the frequency domain.

B Only the digital signals can be multiplexed in the frequency domain.

*C Only the analog signals can be multiplexed in the frequency domain.

D The digital signals cannot be multiplexed in the time domain.

E The analog signals cannot be multiplexed in the time domain.

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22 Which of the following items is a correct IPv6 address:

*A 2607:f0d0:1002:51::4

B 2607:f0g0:1002:51::4

C 2607:f0d0:1002:51:::4

D 2607:f0d0:1002:0051:0000:0000:0000:0004

E 2607.f0d0.1002.51.4

23 Let the computer A have the IP address 10.10.0.10 with the network mask of 255.255.255.0 and the computer B have the IP address 10.0.10.10 with the network mask of 255.255.0.0. Both computers are connected to their routers via metalic UTP cable. If the computer A sends a packet to computer B:

*A the packet must be sent to the gateway of network 10.10.0.0

B the packet must be sent to the gateway of network 10.0.0.0

C the packet is sent directly to computer B

D first, the computer A discovers the hardware address of the computer B network card using the ARP protocol, then the packet is sent to this MAC address

E packet cannot be sent, because the network masks are not compatible

24 Consider the context of access control for wireless transmission. The medium used for the propagation of electromagnetic radiation is equivalent to the physical wired network that uses a topology of:

A ring

*B bus

C tree

D star

E complete interconnection (peer-to-peer)

25 The highest theoretically achievable data transfer speed (in b/s) in a transmission medium is most limited by:

A the frequency of the processor of the sending computer

B the frequency of the carrier signal

C the encoding of the transmitted information into signal elements

*D the ratio of the emitted energy and the noise energy as well as the usable frequency range of the transmission medium

E the minimum of the processor frequencies of the receiving and the sending computers

Software engineering

26 Which of the following statements about functional and non-functional software requirements is true?

A Non-functional requirements define the procedures that the system shall not execute.

B Reliability belongs to the class of functional requirements.

C The classification of system requirements to functional and non-functional is aimed at revealing inconsistencies among requirements.

D Functional requirements must be specified prior to non-functional requirements.

*E Security, performance and testability belong to the class of non-functional requirements.

27 Which of the following activities **should not** be part of refactoring?

A reduction of code complexity

B improvement of code understandability

C architectural changes

D splitting of complex classes and functions into simpler elements

*E implementation of new functionality

28 Which testing technique would you choose to verify whether a change in a tested system did or did not introduce new defects?

A alpha testing

B beta testing

*C regression testing

D acceptance testing

E unit testing

29 Which of the following statements about design patterns is **false**?

A Design patterns describe solutions to commonly occurring problems within the context of software design.

B A design pattern is not a finished design, but rather a design template that can be used in many different situations.

C Object-oriented design patterns typically show relationships and interactions between classes or objects.

*D Design patterns primarily focus on security problems within software.

E An example of a design pattern is the Singleton pattern that ensures the existence of at most one instance of a specific class.

30 Which of the following terms has **no** (or has the weakest) connection to the agile software development?

A SCRUM

B Extreme programming (XP)

*C Yourdon analysis

D Test Driven Development (TDD)

E Lean Software Development